

# PATENT SPECIFICATION (11)

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- (21) Application No. 35453/75 (22) Filed 28 Aug. 1975 (19)  
 (31) Convention Application No. 2 441 361  
 (32) Filed 29 Aug. 1974 in  
 (33) Fed. Rep. of Germany (DE)  
 (44) Complete Specification published 23 Aug. 1978  
 (51) INT. CL.<sup>7</sup> A47L 15/14  
 (52) Index at acceptance  
 A4F 29A1E3 29A2A 29A2DX 29A2E1 29A2F



## (54) METHOD OF WASHING CROCKERY IN A DISH WASHING MACHINE

(71) We, BOSCH-SIEMENS HAUSGERATE GmbH, a German Company, of 8 Prannerstrasse, 8000 Munich 2, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a method of washing crockery in a dish washing machine.

In a known method, washing liquid is fed to and removed from a washing container in the machine during preliminary rinsing, washing, intermediate rinsing and final rinsing cycles of a programme, is, if required, heated by a heating device and is sprayed onto the crockery by means of a spray device.

In this known method, a single quantity of liquid is introduced into the washing container of the dish washing machine at the commencement of the washing cycle, and is at the same time heated by the heating device and sprayed onto the crockery by the spray device, no further liquid being introduced into the container during this cycle. However, in addition to the high initial intake of liquid, the disadvantages of this method include the consumption of a substantial amount of energy which is required for heating this single quantity of liquid. The costs of rinsing are also high.

A feature of the invention is to avoid the disadvantages of this known method and to provide, in a simple manner, an inexpensive method of washing crockery with a satisfactory washing result.

In accordance with the present invention, a method of washing crockery in a dish-washing machine comprises subjecting the crockery to a preliminary rinsing cycle during which washing liquid is fed to a washing container, is sprayed through a spray device onto the crockery and is removed from the washing container, a washing cycle having a first phase during which a first quantity of washing liquid is introduced into the washing container, is heated by a heating device and is sprayed onto the crockery at a first pressure, and a

second phase commencing after the liquid has reached a predetermined temperature, during which second phase cold water is added to the first quantity of washing liquid to provide a second quantity of washing liquid, said second quantity of washing liquid, said second quantity of washing liquid then being sprayed onto the crockery at a second pressure higher than the first until the end of the washing cycle and being removed from the washing container, and intermediate and final rinsing cycles during each of which washing liquid is fed to the washing container, sprayed onto the crockery and removed from the container.

This method is advantageous in that by comparison with the known method previously mentioned a small amount of energy is required, during the first phase of the washing cycle, for heating the small quantity of liquid, this quantity being adequate for softening the food residues adhering to the crockery. Furthermore, the first, low spray pressure reduces the noise as compared with that produced by the dish washing machine using the known method. The spray pressure of the washing liquid, increased during the second phase, fully removes the softened food residues from the crockery. The feeding of cold water during the second phase reduces the temperature of the washing liquid and protects the decoration on the crockery as well as reducing the corrosion of glass parts.

Advantageously, the ratio of the quantity of washing liquid in the washing container during the first phase to that during the second phase is approximately 1:2.

Preferably, a washing agent is added to the washing liquid during the first phase of the washing cycle, and in order to reduce the washing costs and the detrimental effects upon the environment, the quantity of washing agent which is added is determined by the quantity of liquid in the washing container during the first phase of the washing cycle.

An advantageous development of the method resides in the fact that the spray pressure during the majority of the first

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phase of the washing cycle and the first quantity of liquid are at least as high and as great respectively, as the spray pressure and quantity of liquid in the washing container during the majority of the final rinsing cycle, while the spray pressure during the majority of the second phase of the washing cycle and the second quantity of liquid are approximately as high and as great, respectively, as the spray pressure and quantity of liquid in the washing container during the majority of the preliminary rinsing cycle. This is advantageous in that, in the final rinsing cycle, a small quantity of liquid, corresponding in volume to said first quantity, to which a final rinsing agent is added and said first spray pressure are sufficient. On the other hand in the preliminary rinsing cycle, a larger quantity of liquid, corresponding in volume to said second quantity and said second spray pressure are required in order to detach the greatest possible portion of the food residues adhering to the crockery at the commencement of the dish-washing programme.

Conveniently, the washing liquid used in the intermediate rinsing cycle of the programme is sprayed onto the crockery at said first pressure. This low spray pressure is sufficient to remove the residues, adhering to the crockery, of the alkaline washing liquid used during the washing cycle of the programme.

The invention will be described further, by way of example, with reference to the accompanying simplified graphs in which the temperature  $T$  of crockery in a dish washing machine in degrees Celsius, the quantity  $V$  in litres of liquid contained in a washing container of a dish washing machine, and the spray pressure  $p$  of the washing liquid in bars, respectively, are plotted against the duration  $t$ , in minutes, of a programme.

The method of washing crockery in a dish washing machine is subdivided, during a programme, into a preliminary rinsing cycle A, a washing cycle B, an intermediate rinsing cycle C, a final rinsing cycle D, and a drying cycle E. The washing cycle B of the programme is subdivided into a first phase  $b1$  and a second phase  $b2$ . The duration of a programme is approximately 58 minutes.

At the commencement of the preliminary rinsing cycle A of the programme, 10 litres of cold water are introduced into a washing container of the dish washing machine from a mains water supply. A circulating pump, which feeds the liquid with increasing pressure to a device for spraying the crockery to be washed, is switched on at the commencement of the filling operation. A relatively high pressure of 0.4 bar is attained at the end of the filling operation.

The crockery is sprayed with washing liquid at this pressure for 2 minutes during which time the washing liquid removes food residues loosely adhering to the crockery. The washing liquid containing these food residues is drawn from the washing container at the end of the rinsing cycle.

During the first phase  $b1$  of the washing cycle B of the programme, 5 litres of liquid are introduced into the washing container of the dish washing machine and are circulated by the pump. At the end of this filling operation, the washing liquid attains a pressure of 0.2 bar which is retained for the rest of the phase  $b1$ . The relatively low pressure of the washing liquid sprayed onto the crockery in comparison with the pressure achieved during the preliminary rinsing cycle A is obtained in a simple manner by constructing and arranging the circulating pump such that it draws in an increased amount of air when the liquid in the washing container is at a reduced level compared with its level in the preliminary rinsing cycle A of the programme. Alternatively, however, the spray pressure may be reduced by regulating the drive motor of the circulating pump, or by actuating a throttle between the circulating pump and the spray device, or by forming a by-pass between the pump and the washing container. During the phase  $b1$ , the washing liquid is heated to a temperature of 55°C by means of a heating device, and, while the liquid is being heated up, a washing agent is added (point  $b3$  on the temperature graph), the wetting power of the washing liquid and the dirt absorbing capacity of the liquid with respect to food residues thus being increased. The quantity of the washing agent is matched to the quantity of liquid used in the first phase  $b1$  of the washing cycle B of the programme, i.e. the quantity of washing agent required in known dish washing machines for 10 litres of washing liquid can be reduced to half with 5 litres of liquid.

Shortly after a temperature of 55°C has been attained, the washing machine enters the second phase  $b2$  of the washing cycle B of the programme and the quantity of washing liquid is increased to 10 litres by introducing 5 litres of fresh cold water. The ratio of the quantity of washing liquid used in the first phase  $b1$  to the quantity of washing liquid used in the second phase  $b2$  is 1:2. The intake of the cold water reduces the overall temperature of the liquid, and thus also the temperature of the crockery, to 50°C, this temperature being substantially maintained until the end of the programme cycle B owing to the fact that the heating device is inoperative throughout the second phase  $b2$ . The food residues still adhering to the crockery are completely detached by spraying the crock-

ery with the increased volume of liquid, at an increased pressure of 0.4 bar. The quantity of liquid within the washing container and the spray pressure in the second phase b2 of the washing cycle B of the programme are equal to those in the preliminary rinsing cycle A of the programme. The programme cycle B is terminated by draining the washing liquid carrying the food residues from the washing container of the dish washing machine. The duration of the first phase b1 is 16 minutes, and the duration of the second phase b2 is 4 minutes.

During the intermediate rinsing cycle C of the programme, 10 litres of fresh cold water are introduced into the washing container, and are sprayed onto the crockery at a pressure of 0.4 bar. The spray pressure of the washing liquid can be reduced (broken line in pressure graph) by suitable measures during the intermediate rinsing cycle C, in order to reduce the noise caused by rinsing, since no more food residues have to be carried away by the washing liquid. Owing to the inflow of cold water and to the fact that the heating device is switched off, the temperature of the crockery drops to 35°C. The intermediate rinsing cycle C is concluded by pumping the washing liquid out of the washing container of the dish washing machine.

The final rinsing cycle D of the programme commences with the introduction of 5 litres of fresh cold water into the washing container of the dish washing machine. The liquid is sprayed onto the crockery at a pressure of 0.2 bar. The quantity of liquid, and the spray pressure, used in the final rinsing cycle D are equal to those used in the first phase b1 of the washing cycle B of the programme. The washing liquid is heated to 68°C by the heating device which is switched on once the washing container is filled, the liquid reaching this temperature a few minutes before the end of the final rinsing cycle D of the programme. At the instant d1, a final rinsing agent is added to the washing liquid to soften the washing liquid and so to prevent hardening constituents of the washing liquid from being deposited on the washed crockery. The final rinsing cycle D of the programme is terminated by pumping the washing liquid out of the washing container of the dish washing machine.

The drying cycle E of the programme now follows, during which the heating device remains switched on and maintains the crockery at a temperature of 68°C for the purpose of evaporating washing liquid which remains adhering to the washed crockery. The programme is terminated

after 58 minutes by switching off the heating device.

#### WHAT WE CLAIM IS:—

1. A method of washing crockery in a dish-washing machine comprising subjecting the crockery to a preliminary rinsing cycle during which washing liquid is fed to a washing container, is sprayed through a spray device onto the crockery and is removed from the washing container, a washing cycle having a first phase during which a first quantity of washing liquid is introduced into the washing container, is heated by a heating device and is sprayed onto the crockery at a first pressure, and a second phase commencing after the liquid has reached a predetermined temperature, during which second phase cold water is added to the first quantity of washing liquid to provide a second quantity of washing liquid, said second quantity of washing liquid then being sprayed onto the crockery at a second pressure higher than the first until the end of the washing cycle and being removed from the washing container, and intermediate and final rinsing cycles during each of which washing liquid is fed to the washing container, sprayed onto the crockery and removed from the container.

2. A method as claimed in claim 1 in which the ratio of the first quantity of washing liquid in the washing container during the first phase to the second quantity of liquid in the container during the second phase is approximately 1:2.

3. A method as claimed in claim 1 or 2, wherein the heating device is inoperative throughout the second phase of the washing cycle.

4. A method as claimed in claim 1, 2 or 3 in which a predetermined quantity of washing agent is added to the washing liquid during the first phase of the washing cycle.

5. A method as claimed in claim 1, 2, 3 or 4 wherein the spray pressure during the majority of the first phase of the washing cycle and the first quantity of liquid are at least as high and as great respectively, as the spray pressure and quantity of liquid in the washing container during the majority of the final rinsing cycle.

6. A method as claimed in any preceding claim, in which the spray pressure during the majority of the second phase of the washing cycle and the second quantity of liquid are approximately as high and as great, respectively, as the spray pressure and quantity of liquid in the washing container during the majority of the preliminary rinsing cycle.

7. A method as claimed in any preceding claim, in which the washing liquid is sprayed onto the crockery at said first pressure in the intermediate rinsing cycle.

8. A method of washing crockery in a dish washing machine substantially as herein particularly described with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1978.  
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY  
from which copies may be obtained.

